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ABSTRACT

This paper discusses designing learning environments based on the Internet, as seen from a constructivist/situated learning point of view. First, some of the main principles of learning theory are examined. The structuring of virtual learning environments and integrated use of services on the Internet within the following five areas are addressed: (1) presentation/lecture area, including text files, World Wide Web sites, overheads, video, and animation; (2) knowledge area, including help service, FAQs (frequently asked questions); (3) communication area, including computer networks, e-mail, and groupware; (4) working area, including software tools, groupware, and workbook; and (5) private area, including private files, workbook, and personal work/study plan. Tools for developing entirely net-based learning environments, where the resources in the network work together to support the learning process, are presented. A closer look at some models for integrating network-based learning environments and learning organizations/social context are described. The authors' work on a network-based concept that includes administrative tasks is noted briefly. (MES)

How to create a Learning Environment on the Internet, based on constructivism and sociocoultural approaches?

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Abstract: This paper is about designing learning environments based on the Internet seen from a constuctivistic-/situated learning point of view. First, we'll take a look at some of the main principles of learning theory before we move on to the structuring of virtual learning environments and integrated use of services on the Internet. We will also present tools for developing entirely netbased learning environments, where the resources in the network work together to support the learning process. Last, we'll take a closer look at some models for integrating network-based learning environments and learning organizations/social context. The network-based concept that we're working on does also include administrative tasks, such as student registration, course-base, salary, exam, etc. This will not be further dealt with here.

Background

The universities are being criticized for creating passive students and for teacher managed methods, based on old behavioristic learning theories. When Information- and Communication Technology (ICT) now makes it's entry, there is a risk that teacher managed models will be copied into network-based learning.

The last few years, The Norwegian University of Technology and Science (NTNU) in collaboration with other universities/colleges and companies, both nationally and internationally, has been working actively towards the development of a more flexible, problem- and project-based learning, in which network-based learning creates the foundation. Constructivistic learning-theory and situated learning, have formed the pedagogical background, not least in order to be capable of offering flexible learning possibilities when it comes to lifelong learning and the need for continuing vocational training in trade and industry.

Constructivistic learning theory/situated learning

From a historical perspective the design of the first computer-based training programs was based on behavioristic learning theory, where learning is thought of as passive acquirement, or absorption, of an already existing and often rigidly defined amount of information. The main role of the teacher is to gather formal knowledge, to find efficient ways of distributing this knowledge, and to control that the students have acquired the taught material. Then cognitive learning theory followed, focusing on how the material is presented, and development of computer-based ways of teaching which emphasized the presentational form and intelligent guidance systems.

Even though we can't find the same enthusiasm within learning theory today when it comes to the effect of

such managed and organized teaching, we witness the international education market explode with offers concerning manage-based teaching, especially when these are directed towards continuing vocational training. From our own schooldays we carry with us the knowledge that learning means to be quite, to watch and listen, and then, finally, a test of what we remembered. Thus, it doesn't seem too strange that this model is copied into network-based learning environments, especially not when the Internet as a medium is extremely suitable for fast and comprehensive management and distribution of information, and flexible both in terms of time and place.

However, research on learning theory has for the last few years been increasingly focusing on the fact that learning comes through active participation and collaboration in entire social-/cultural environments. Constructivism was rooted in the perspective that knowledge is acquired through personal construction of knowledge and arose in connection with Piaget's research on developmental psychology. Piaget introduced a theory on learning where new information act together with old knowledge through a process of assimilation and accommodation (Piaget, 1985). Papert (1980) further claims that the activity of programming computers could play an important role in constructivistic learning and related this to his work on the programming language, Logo. Here, the learner plays the role as "teacher" in relation to the computer.

In the 1970s, based on Piaget's theories, a group of psychologists, the so-called Genevan School, carried on research on how social interaction affects each individual's cognitive development. The main-thesis claims that each individual is capable of handling new knowledge by interacting with others. Individual cognition is seen as a spiral of causal connection.

The other theoretical main influence was the research carried on by Russian psychologists who were interested in the cultural basis for human intellect and researchers from the social-cultural perspective. The best known of these Russian researchers is Vygotsky (1978) who formulated the theory on cultural historical psychology. Vygotsky general genetic law of cultural development stipulates that learning always is a two-level process: first as an interpersonal act in a social community and then as an internal/personal process. Internalization refers to the genetic link between the social and the internal plans. Social speech is used for interacting with others, inner speech is used for talking to oneself, for reflection and thought. The social-cultural approach focuses on causal connection and connection between social interaction and individual cognitive change. Vygotsky's theory on "The Zone of Proxymal Development" (ZDP) has been interpretated in various directions. One interpretation claims that ZDP is the difference between a person's ability to solve a problem on his/her own, and what the same person is capable of when collaborating with others. Another interpretation of Vygotsky's ZDP is the distance between an individual's personal knowledge and the knowledge that exists in social situations. In both these interpretations learning happens through social interaction which inspires to individual acquisition and internalization of knowledge.

A related school represented by the Russian researcher Leont'ev (1974) et al., focuses on the role of active participation for human development, the so-called "Activity theory". The basis for analysis is social activity, from which individual mental functions are developed. This one focuses on signs, symbols, rules, methods, instruments and other artifacts which serves to mediate this activity. Vygoysky's cultural-historical psychology, and later on the work of the activity theorists have again developed successors both in relation to educational research and in the specialized area of computer science directed towards human/machine interaction.

In theories on situated learning is seen as a process for entering a practical society. "To learn to use tools as practitioners use them, a student, like an apprentice must enter that community and its culture. Thus in a significant way, learning is, we believe, a process of enculturation" (Brown, Collins, & Duguid, 1989). Within this perspective, the learning context (both social and cultural) is under heavy investigation, from a view which states "that agent, activity, and the world mutually constitute each other" and that knowledge must be presented in an authentic context, in which this knowledge normally is integrated (Lave & Wenger, 1991). For these researchers the environment is a complete part of cognitive activity, and not just a set of relation through which context-dependent cognitive processes are expressed. Collaboration is seen as the process in which a common understanding of a problem is created and maintained. While the earlier approaches focused on the inter-individual levels, common-cognition and situated learning are now focusing on the social level where new concepts are being analyzed as a group-product.

From constructivistic-/situated learning theory we have decided to emphasize three main principles of learning and to look upon these in relation to design of internet-based learning environments:

1. Focus on active actors with intentions and creativity, searching for knowledge and collaborators.

2. Focus on collaboration and communication between the actors

3. Focus on learning in a total context/environment

So, how is it possible to design internet-based learning environments on these main principles?

Structuring a virtual competence environment

Based on these learning theoretical principles, we have tried to find out how available services on the Internet can be structured and used in order to promote a learning environment with active actors genuinely collaborating in a total context. The resources/services that are available in a virtual competence network can be structured in relation to tasks and activities to be emphasized. We have chosen to structure the services into five areas, according to which tasks/theories that are to be dealt with: A presentation-arena for presenting and receiving scientific literature/theories, a knowledge arena for accessing library services/on-line services and other accumulated knowledge, a working arena to manage collected material/information and produce new material, a private arena to make personal notes and reflections, and last a communication arena which, together with the working arena, make up the main core of a learning process based on constructivism and situated learning.

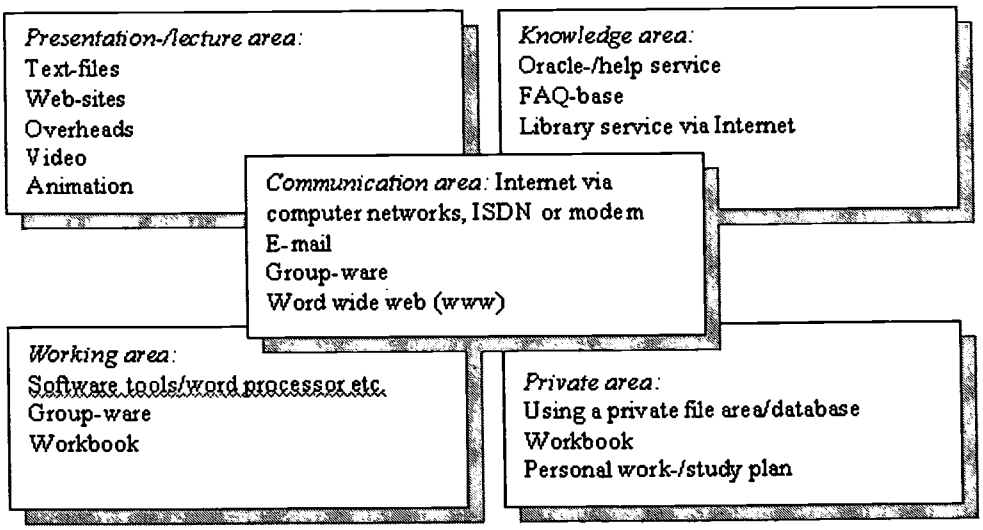

Figure 1: Electronic Learning Environment in Internet

Presentation-/lecture area

The criticism against behavioristic learning theory is especially directed towards the belief that "someone can teach someone something" and that learning can be managed by the teacher. Thus, the possibility of spreading huge amounts of science material in a simple and flexible way by using network-based systems, shouldn't be confused with learning. Science material can be presented and mixed together via network-based systems through different kinds of media, such as text, drawings, pictures, animation, video, and audio. It all depends on the one(s) having the knowledge how this knowledge can be made available to others. The activities related to this arena are on one side to present information and on the other side to receive information. And, vice versa, if the communicating parts are equal. Based on cognitivistic principles, this arena will be important if the material is organized properly.

How great the activity related to this arena will be, depends on the amount of information to be mediated. For example, there will be relatively much more activity on this arena if the system is being used in relation to a defined

material/course (reproducive learning), than in relation to creation, e.g related to learning organizations.

Competence area for accessing library services and other accumulated knowledge

This area is also an information area. However, it's main emphasis is to actively search for information/answers for the topical questions. Thus, accessing databases and libraries will be in the form of searching in relation to accumulated and stored information, while requests made to an oracle service may either be contact with resource persons and/or with accumulated information, e.g. stored answers in "Frequently Asked Questions" (FAQ). The services in both the presentation area and the knowledge area must first of all be seen as resources in relation to the actors learning process.

Working area for organizing and producing science material

Area for personal organizing of material. This is the real learning area, if based on constructivistic learning theory. The learning take place through the actors treatment of information and production of new material. The tools available in this arena are the same as those in the presentation/lecture arena, but now as tools for organizing and producing your own material. Group-ware tools are included also here in relation to personal work but communication with others is done in the communication arena. The workbook is also here when working with personal material but the storage of this one is in the private arena.

Private area for personal notes and reflections

Basically, the private arena is supposed to be used for storing personal material. The private workbook is stored here.

Communication area for interaction and collaboration

Area for communication and organizing in relation to others. Together with the working arena, this is the most important learning arena if based on situated learning. Here, together with group-ware tools, e-mail and the World Wide Web (WWW) create the communicative foundation.

Tools and help services to realize Learning Environments in Internet - Interactive learning system, (ILS)

In order to realize this new network-based learning environment it has been necessary to develop a number of tools and help services in order to increase the smoothness of the layout and the production of network-based scientific literature, and support for the learning co-operation. This tools consist of an infrastructure tool based on the Internet and includes tools for hyper-/multimedia-systems, video on demand, animation, object-orientated design based on constructivistic learning principles, info-search in free text, a knowledge test based on free text, an oracle-/help service, a workbook, and a plan for student administration. We have also developed specifications for necessary services in group-ware, but this tool is not realized yet.

The Infrastructure tool creates the complete frame for the learning area and ties the areas/functions together. Consequently, the areas are able to communicate and use the resources across the borders.

The tool for creating *Hyper-/multimediasystem on Internet* make it possible to use media such as video, navigation, lecture-paths, personal paths, lectures on video synchronized with information in the hyper-system, and the possibility of making personal notes for each node, personal working arena, choosing language, fonts, colors,

background, etc.

The Video on demand tool edits video (e.g. a lecture) and makes it possible to synchronize events in order to find the desired picture/sequence. By using this tool it also becomes possible to edit overheads and animations in relation to a video sequence. This is useful if one wants to use several media in order to strengthen a message. Video on demand is available from 28.8 kb and up to a few hundred, or a few mb if needed. We have chosen to connect the main service for video to Video On Demand instead of Multi Cast. The reason for this is i.a. to be able to reuse already produced material without conflicting the law, copyright. Multi Cast is to be considered as broadcasting and thus it doesn't allow for such an opportunity.

The Animation tool makes it possible to create animations which doesn't demand much band-with. It is also possible to control the animations step-by-step from a video-lecture. For example, this may be desirable if one wants to illustrate a process and explain what's going on simultaneously.

The Object-oriented design tool makes it possible for a teacher or a student to build a set of objects by using their own knowledge about a subject. Based on the objects one may easily construct systems in which the system and the work progress are visualized and animated during the execution.

By use of *the tool for Info-search in free text* one may search for information in free text; the information and the search are compared by use of vectors. Nonsense-answers can be rejected, answers with a touch of reason can be guided. Here, the teacher can decide where to draw the line between nonsense and reason.

The Oracle service/help service tool structures and creates a connection with an on-line help service. Questions and answers are stored for later use in an automatic service for "Frequently Asked Questions".

The Digital workbook structure tool gives possibility to make sure that learning is done through one's own activity and production, activities in an electronic workbook are very important. The workbook is a frame into which the users are supposed to put their own product, and not a book where you fill in the correct answers, or where you practice defined tasks. This workbook is also available to course administrators/tutors in the period of study, so that course-related discussions are connected to the work of the learner and which they show through the product that the workbook will become. It is also possible to share and develop a workbook in collaboration with other students/partners. Connected to the workbook, there are tools for editing, asking for help and possibilities for tutor/colleges to add comments. It is possible to divide the workbook into chapters. Which tasks that are connected to each chapter will depend on whether there is a special course to be completed or whether the workbook is being used as a public domain for documenting the work in progress. If the workbook is to be used in connection to a specific course content, it is up to the course administrator and those participating how to proceed. One example of how to structure the workbook:

- Preface, where the participant presents himself/herself.

- A chapter where a group of persons, single or together, creates an overhead series in order to present a part of the material to each other. That is, the participants function as "teachers" for the rest of the group. They do this in turn so that everyone gets the opportunity to present course material to the others in the group.
- A chapter for writing a summary of lectures/presented material.
- A chapter for practicing exercises. These are solved through discussions and by working in groups.
- A chapter for a project assignment.
- A chapter for miscellaneous.

From a learning theoretical perspective, based on active creative actors in genuine collaboration, we think that the working area and the collaboration area, can create the foundation for such an active collaborative learning process, while the presentation area and the knowledge area can be considered more as resources for the actors work and production. A well-designed network-based learning environment can, as we see it, create the foundation for

active, creative collaborative learning.

Network-based learning environments and learning organizations/social context

According to the principle that learning takes place, and is closely connected to social context/environment, the network-based environment may either be seen as the total learning environment, separated from the social reality where people belongs, or as an integrated part of a bigger social context. When collaborating with companies, municipal services, regions, we have tried to see virtual competence networks as integrated parts of an organizational context representation. However, such an integration demands focusing on internal learning processes and organizational development at the collaborative parts. That is, at both the knowledge institution/university and the company/service. From our point of view, it is through the possibility of collaborating and communicating through network-based environments we enable the possibility of collaboration between environments that genuinely seek each other's competence without considering time and place. However, this requires good effort and a conscious mind, if not, the network-based environment will operate outside the institutions, both from the universities and the companies, and will not be an integrated part of the context.

The Rørvik-model

As an example of such an integrated collaboration-model for developing a total learning environment we want to mention the Rørvik-model (OECD, 1999). The model is based on a close Internet-based collaboration between a small coast society (Rørvik), four universities/colleges (NITOL – Norwegian net with IT for Open and distance Learning) and a local upper secondary school (Ytre Namdal Upper Secondary School - YNVS). The local high school plays the role as the worlds best mediator to Internet-based university education and training for the local population in this area. This due to the close collaboration between the local upper secondary school and local industry.

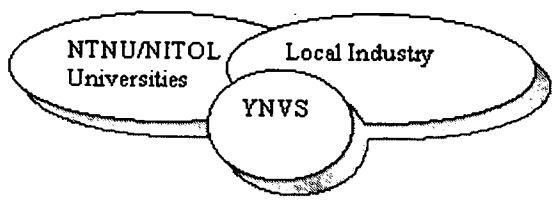

Figure 2: The Rørvik-model

The background to this project was that one of the companies in Rørvik (Telenor Mobil) needed higher education for their employees, and therefore they contacted the local high school (YNVS) to ask for help for such education. YNVS then contacted NTNU/NITOL, which has for the last few years been arranging off- and on-campus learning based on Internet solutions. Later on, this collaboration has grown to concise several companies in the Rørvik area, municipal authorities has joined the project, i.a. many of the teachers in the area have attended continuing vocational training at university level through this collaboration. The results are very good. In 1998, of those who had started a locally mediated Internet-based university-/college course, 96% graduated. There were only 4 out of 350 who failed the exam, and the average grade was 0.2 above the average for other students who took the same courses at universities/colleges.

Conclusion

Based on constructivism and sociocultural approaches we have tried to arrange for a network-based learning

environment that supports active, creative actors in a genuine collaboration within a total context. From our point of view, there is a great challenge in seeing the context as the foundation for integrating network-based learning, this applies not least to lifelong learning and continuing vocational training related to working place/environment. We have up gained some experience in this interesting area by developing tools so that people with competence in one or several specialist areas could be able to express this knowledge in an internet-based competence-network, and to collaborate with others. There is still a lot of work to be done, both with learning theory, methodology and tool development.

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